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forth in paragraphs (c)(2) and (c)(3) of this section:

(2) Each collision post acting together with its supporting car body structure shall be capable of withstanding the following loads individually applied at any angle within 15 degrees of the longitudinal axis:

(i) A 500,000-pound horizontal force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(ii) A 200,000-pound horizontal force applied at a point 30 inches above the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure; and

(iii) A 60,000-pound horizontal force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure.

(3) Prior to or during structural deformation, each collision post acting together with its supporting car body structure shall be capable of absorbing a minimum of 135,000 foot-pounds of energy (0.18 megajoule) with no more than 10 inches of longitudinal, permanent deformation into the occupied volume, in accordance with the following:

(i) The collision post shall be loaded longitudinally at a height of 30 inches above the top of the underframe;

(ii) The load shall be applied with a fixture, or its equivalent, having a width sufficient to distribute the load directly into the webs of the post, but of no more than 36 inches, and either:

(A) A flat plate with a height of 6 inches; or

(B) A curved surface with a diameter of no more than 48 inches; and

(iii) There shall be no complete separation of the post, its connection to the underframe, its connection to either the roof structure or anti-telescoping plate (if used), or of its supporting car body structure.

(d) The end structure requirements of this section apply only to the ends of a semi-permanently coupled consist of articulated units, provided that:

(1) The railroad submits to FRA under the procedures specified in

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§ 238.21 a documented engineering analysis establishing that the articulated connection is capable of preventing disengagement and telescoping to the same extent as equipment satisfying the anti-climbing and collision post requirements contained in this subpart; and

(2) FRA finds the analysis persuasive.

[75 FR 1228, Jan. 8, 2010]

§ 238.213 Corner posts.

(a)(1) Except as further specified in paragraphs (b) and (c) of this section and § 238.209(b), each passenger car shall have at each end of the car, placed ahead of the occupied volume, two full-height corner posts, each capable of resisting together with its supporting car body structure:

(i) A 150,000-pound horizontal force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(ii) A 20,000-pound horizontal force applied at the point of attachment to the roof structure, without exceeding the ultimate strength of either the post or its supporting car body structure; and

(iii) A 30,000-pound horizontal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure.

(2) For purposes of this paragraph (a), the orientation of the applied horizontal forces shall range from longitudinal inward to lateral inward.

(b)(1) Except as provided in paragraph (c) of this section, each cab car and MU locomotive ordered on or after May 10, 2010, or placed in service for the first time on or after March 8, 2012, shall have at its forward end, in lieu of the structural protection described in paragraph (a) of this section, two corner posts ahead of the occupied volume, meeting all of the requirements set forth in paragraphs (b)(2) and (b)(3) of this section:

(2) Each corner post acting together with its supporting car body structure shall be capable of withstanding the following loads individually applied toward the inside of the vehicle at all angles in the range from longitudinal to lateral:

(i) A 300,000-pound horizontal force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(ii) A 100,000-pound horizontal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure; and

(iii) A 45,000-pound horizontal force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure.

(3) Prior to or during structural deformation, each corner post acting together with its supporting car body structure shall be capable of absorbing a minimum of 120,000 foot-pounds of energy (0.16 megajoule) with no more than 10 inches of longitudinal, permanent deformation into the occupied volume, in accordance with the following:

(i) The corner post shall be loaded longitudinally at a height of 30 inches above the top of the underframe;

(ii) The load shall be applied with a fixture, or its equivalent, having a width sufficient to distribute the load directly into the webs of the post, but of no more than 36 inches and either:

(A) A flat plate with a height of 6 inches; or

(B) A curved surface with a diameter of no more than 48 inches; and

(iii) There shall be no complete separation of the post, its connection to the underframe, its connection to either the roof structure or anti-telescoping plate (if used), or of its supporting car body structure.

(c)(1) Each cab car and MU locomotive ordered on or after May 10, 2010, or placed in service for the first time on or after March 8, 2012, utilizing low-level passenger boarding on the non-operating side of the cab end shall meet the corner post requirements of paragraph (b) of this section for the corner post on the side of the cab containing the control stand. In lieu of the requirements of paragraph (b) of this section, and after FRA review and approval of a plan, including acceptance criteria, to evaluate compliance with this paragraph (c), each such cab car

and MU locomotive may have two corner posts on the opposite (non-operating) side of the cab from the control stand meeting all of the requirements set forth in paragraphs (c)(2) through (c)(4) of this section:

(2) One corner post shall be located ahead of the stepwell and, acting together with its supporting car body structure, shall be capable of withstanding the following horizontal loads individually applied toward the inside of the vehicle:

(i) A 150,000-pound longitudinal force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(ii) A 30,000-pound longitudinal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure;

(iii) A 30,000-pound longitudinal force applied at the point of attachment to the roof structure, without permanent deformation of either the post or its supporting car body structure;

(iv) A 20,000-pound longitudinal force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure;

(v) A 300,000-pound lateral force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(vi) A 100,000-pound lateral force applied at a point 18 inches above the top of underframe, without permanent deformation of either the post or its supporting car body structure; and

(vii) A 45,000-pound lateral force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure.

(3) A second corner post shall be located behind the stepwell and, acting together with its supporting car body structure, shall be capable of withstanding the following horizontal loads individually applied toward the inside of the vehicle:

(i) A 300,000-pound longitudinal force applied at a point even with the top of

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the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(ii) A 100,000-pound longitudinal force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure;

(iii) A 45,000-pound longitudinal force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure;

(iv) A 100,000-pound lateral force applied at a point even with the top of the underframe, without exceeding the ultimate strength of either the post or its supporting car body structure;

(v) A 30,000-pound lateral force applied at a point 18 inches above the top of the underframe, without permanent deformation of either the post or its supporting car body structure; and

(vi) A 20,000-pound lateral force applied at any height along the post above the top of the underframe, without permanent deformation of either the post or its supporting car body structure.

(4) Prior to or during structural deformation, the two posts in combination acting together with their supporting body structure shall be capable of absorbing a minimum of 120,000 foot-pounds of energy (0.16 megajoule) in accordance with the following:

(i) The corner posts shall be loaded longitudinally at a height of 30 inches above the top of the underframe;

(ii) The load shall be applied with a fixture, or its equivalent, having a width sufficient to distribute the load directly into the webs of the post, but of no more than 36 inches and either:

(A) A flat plate with a height of 6 inches; or

(B) A curved surface with a diameter of no more than 48 inches; and

(iii) The corner post located behind the stepwell shall have no more than 10 inches of longitudinal, permanent deformation. There shall be no complete separation of the corner post located behind the stepwell, its connection to the underframe, its connection to either the roof structure or anti-telescoping plate (if used), or of its supporting car body structure. The corner

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post ahead of the stepwell is permitted to fail. (A graphical description of the forward end of a cab car or an MU locomotive utilizing low-level passenger boarding on the non-operating side of the cab end is provided in Figure 1 to subpart C of this part.)

[75 FR 1229, Jan. 8, 2010]

§ 238.215 Rollover strength.

(a) Each passenger car shall be designed to rest on its side and be uniformly supported at the top (“roof rail”), the bottom cords (“side sill”) of the side frame, and, if bi-level, the intermediate floor rail. The allowable stress in the structural members of the occupied volumes for this condition shall be one-half yield or one-half the critical buckling stress, whichever is less. Local yielding to the outer skin of the passenger car is allowed provided that the resulting deformations in no way intrude upon the occupied volume of the car.

(b) Each passenger car shall also be designed to rest on its roof so that any damage in occupied areas is limited to roof sheathing and framing. Other than roof sheathing and framing, the allowable stress in the structural members of the occupied volumes for this condition shall be one-half yield or one-half the critical buckling stress, whichever is less. Deformation to the roof sheathing and framing is allowed to the extent necessary to permit the vehicle to be supported directly on the top chords of the side frames and end frames.

§ 238.217 Side structure.

Each passenger car shall comply with the following:

(a) *Side posts and corner braces.* (1) For modified girder, semi-monocoque, or truss construction, the sum of the section moduli in inches³—about a longitudinal axis, taken at the weakest horizontal section between the side sill and side plate—of all posts and braces on each side of the car located between the body corner posts shall be not less than 0.30 multiplied by the distance in feet between the centers of end panels.

(2) For modified girder or semi-monocoque construction only, the sum of the section moduli in inches³—about a transverse axis, taken at the weakest horizontal section between the side sill